BNL neutrino beam. Optimization and simulations

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June 10

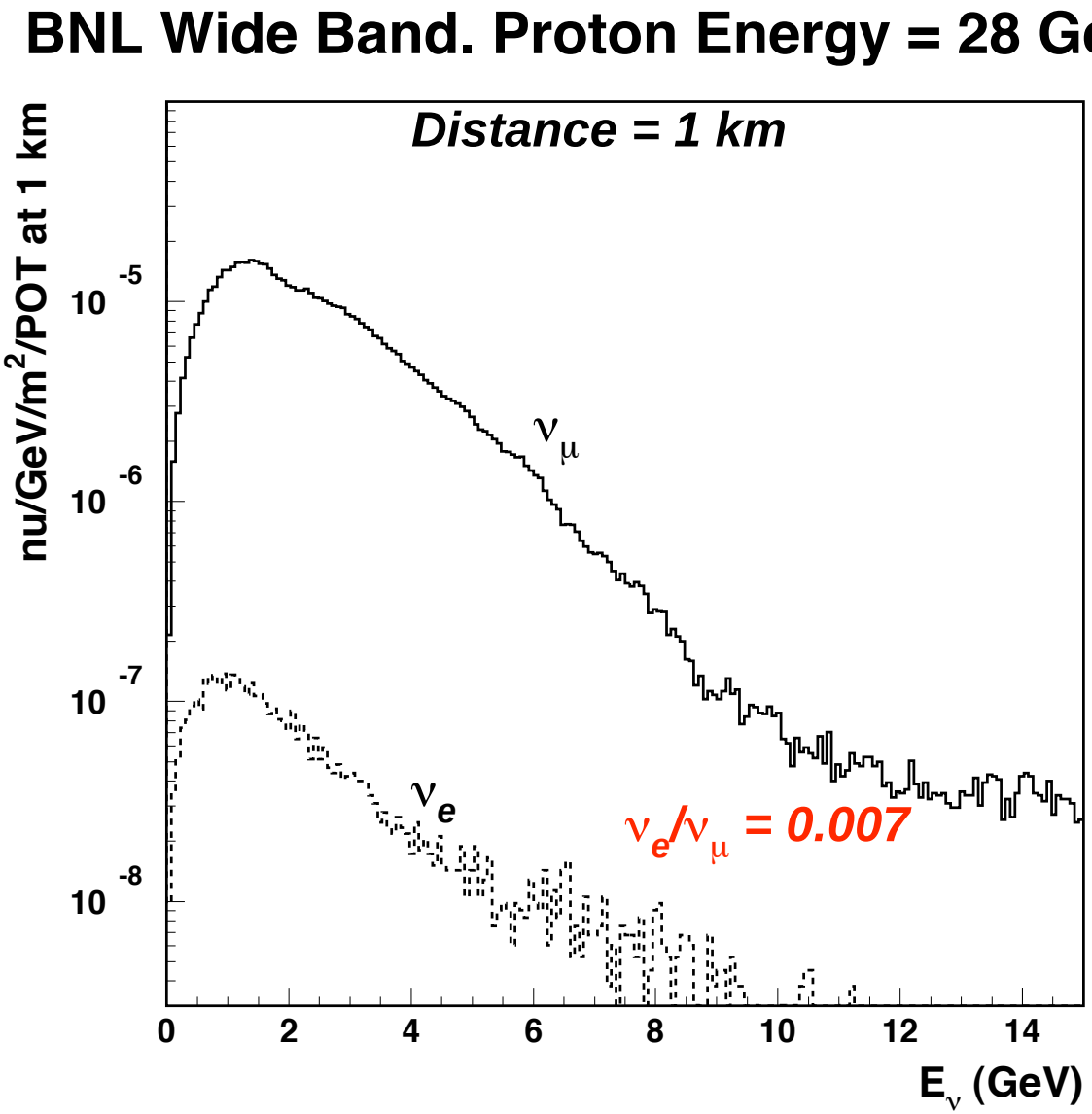
What was done

- Geant 3.0 simulations with details of horn geometry including materials.
- 180 m tunnel with 4 meter diameter
- Default parameters not quite the same as rest of report.
- pbeam study of parameters.

List of parameters for GEANT simulation

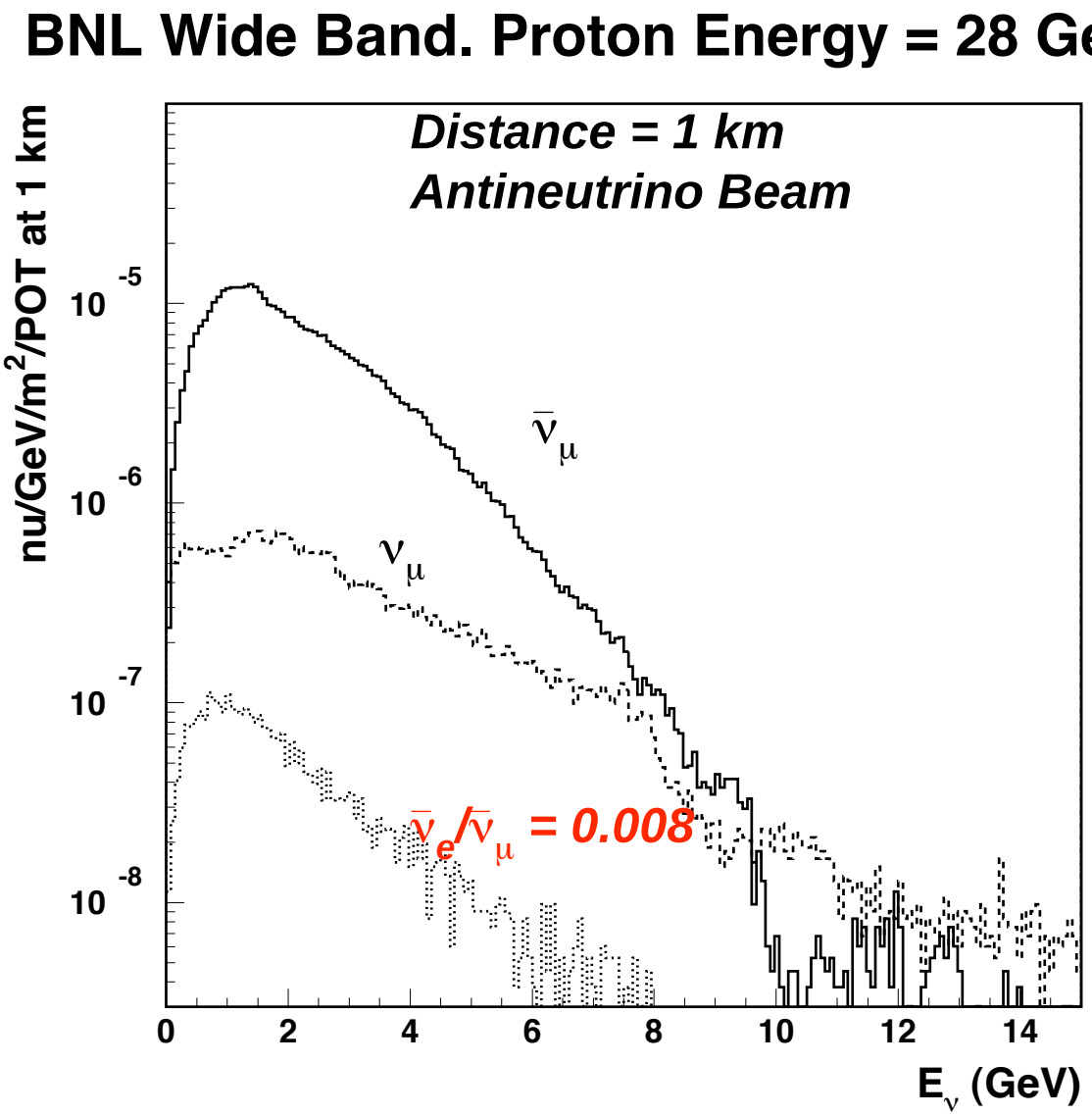
- target: radius: 3.2 mm, length: 60 cm, den: 2.2 gm/cc
- beam: 28 GeV, radius: 1 mm
- horn: gap: 1 mm, H1length: 2.2m, H2length: 1.5 m
- tunnel: radius: 2 m, length: 180 m, Air-filled
- 2 horn distance: 8.3 m

Flux: things to optimize



- Total flux or event rate
- Width of flux: as wide as possible
- electron neutrino contamination: as low as possible.

Anti-neutrinos



- Lower event rate => 2 MW
- Much larger neutrino contamination.
- 30% of events due to wrong sign.

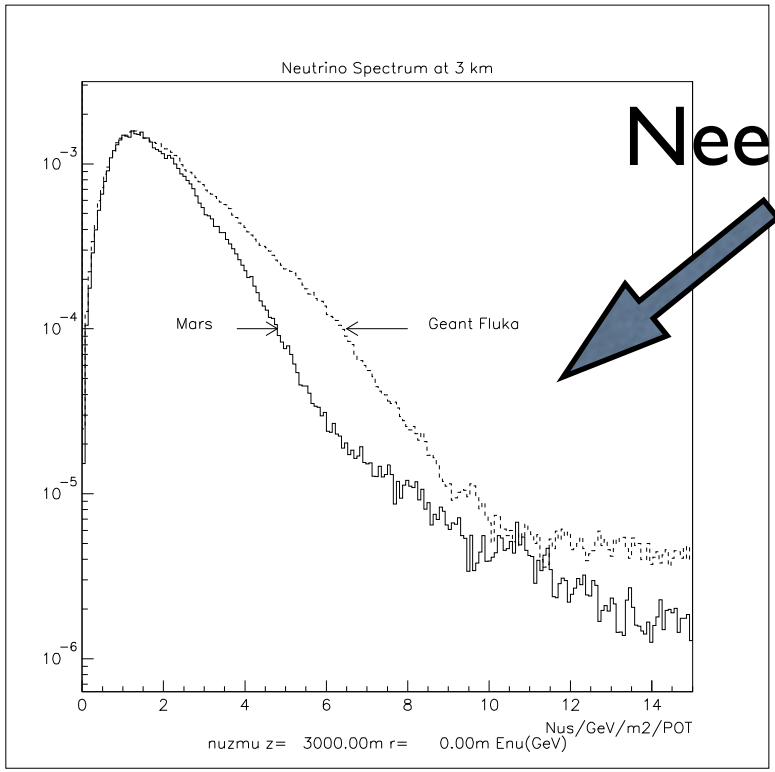
Canonical event rates

- 1.12e22 protons, 500 kT, 2540 km
- Neutrinos: CC: 52000, NC: 17000
- Anti-neutrinos: CC: 14000, NC: 5400
- Assumes extrapolation as 1/2540**2

Concerns

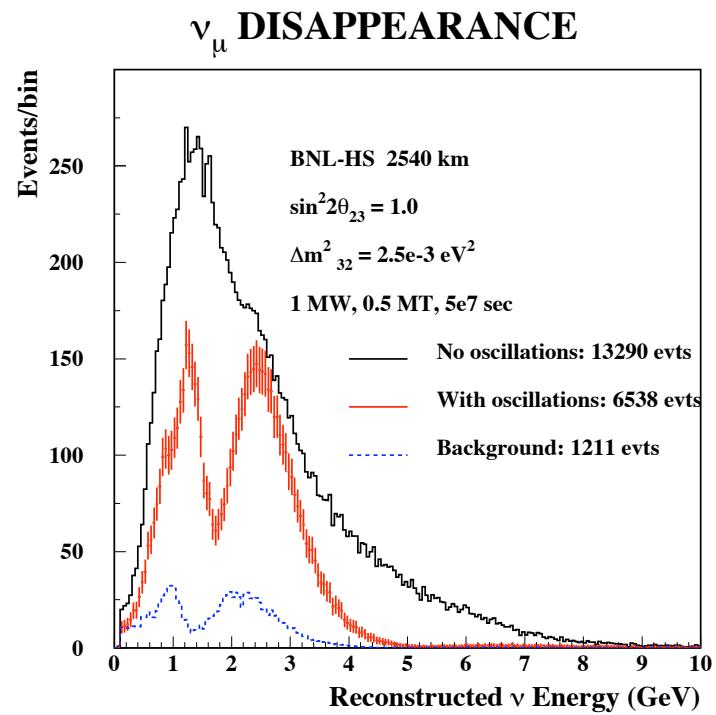
- Uncertainty on total flux or event rate probably still 20-30%.
- Large (50%) uncertainty above 4 GeV.
- Is off-axis running at all possible ?
- Can all be addressed by more beam power.

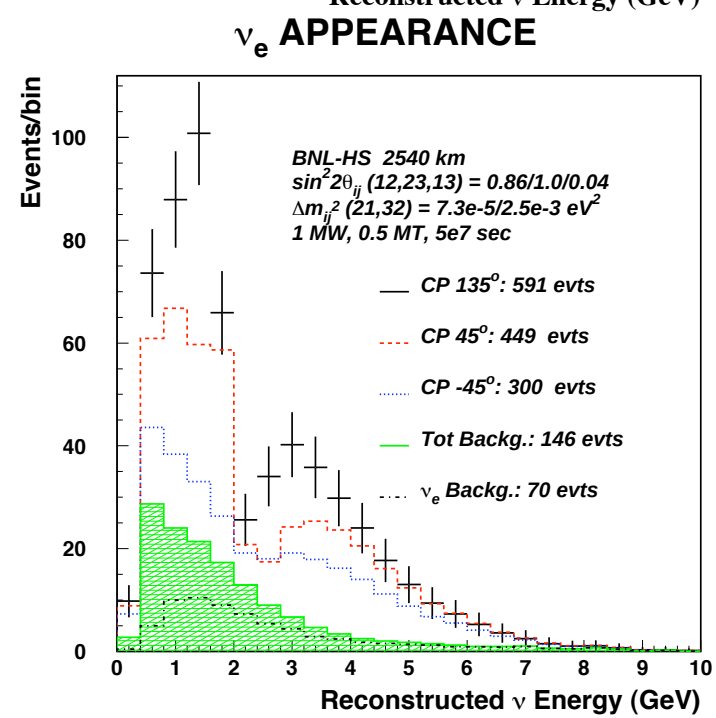
Hadronic models



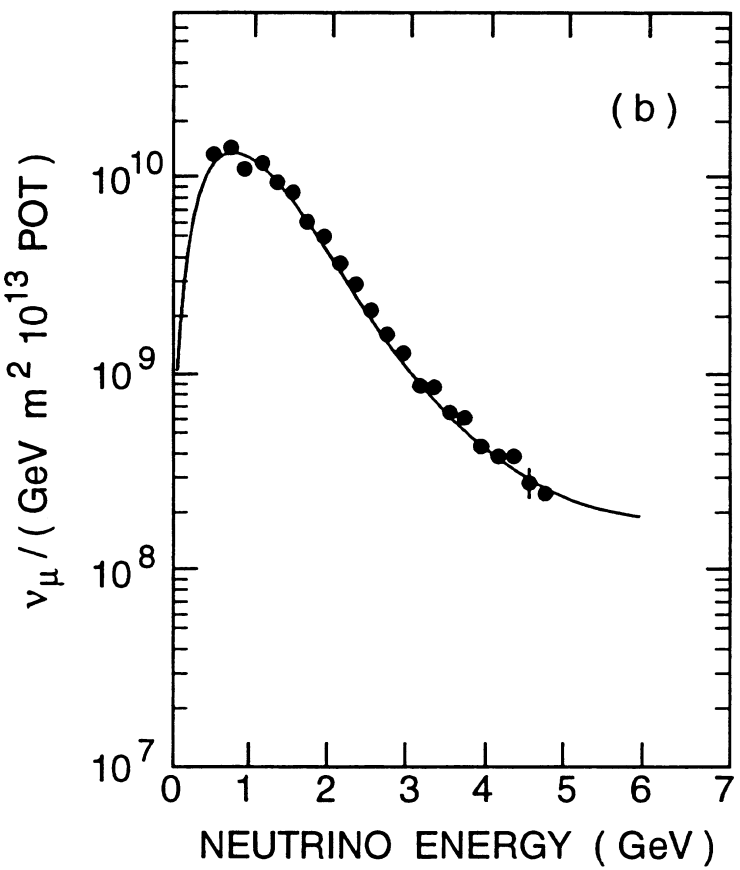
Needs study

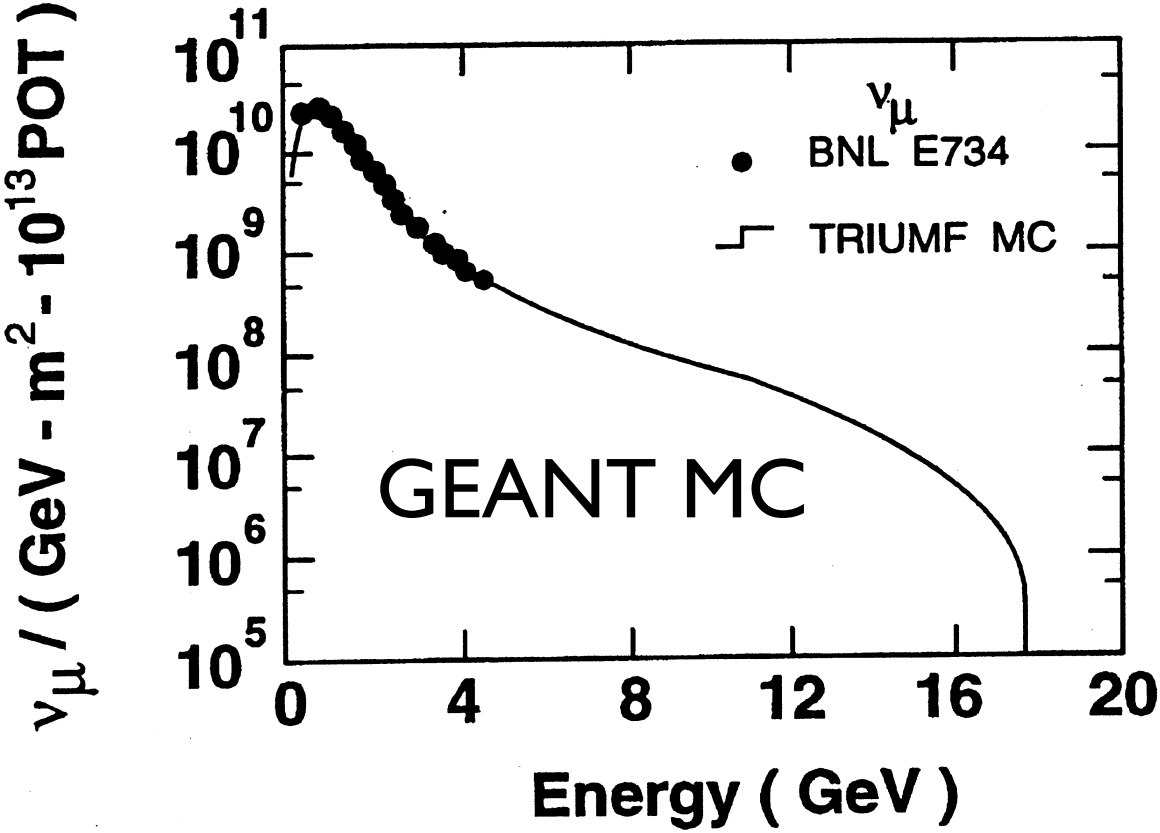
- Good news: less backg at low energy.
- Bad news: less signal at high energy.





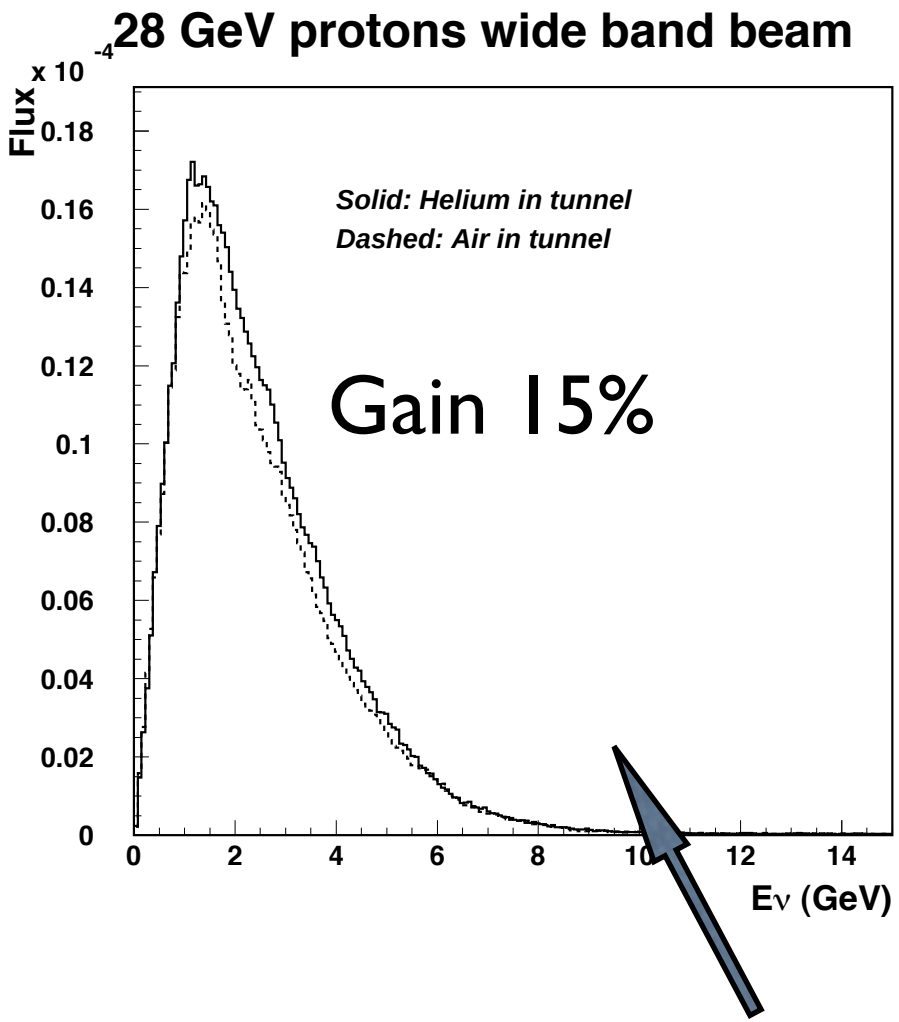
Data on beam ?

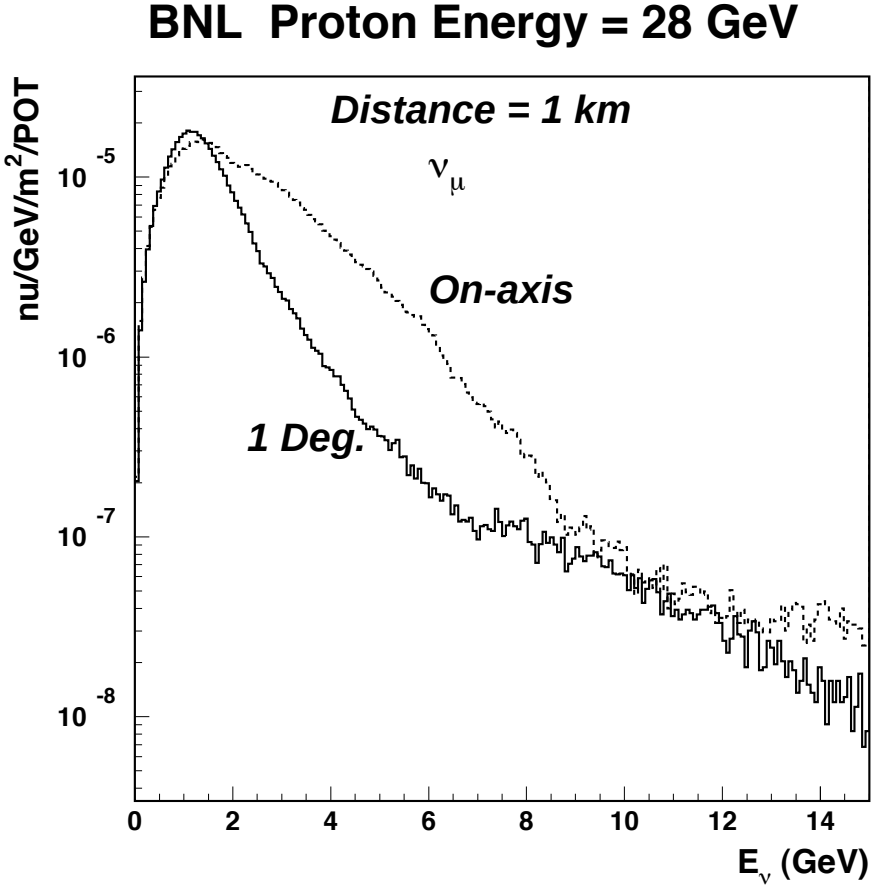




- E734 target Cu, different Horn design
- E734 data suggests enough flux at GeV

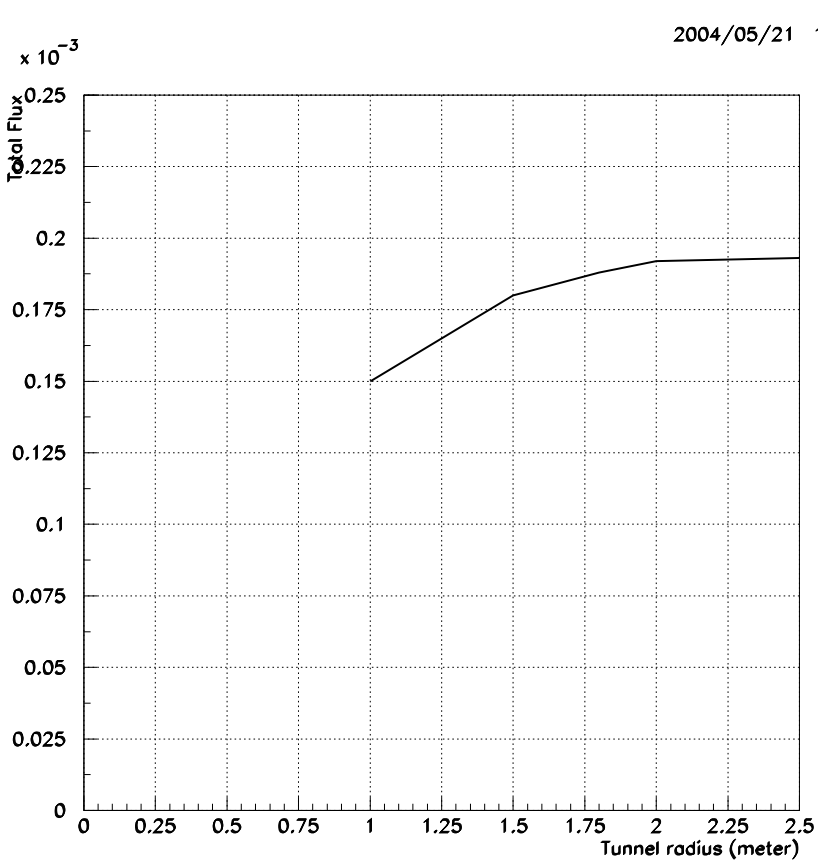
Ways to gain or lose high E flux

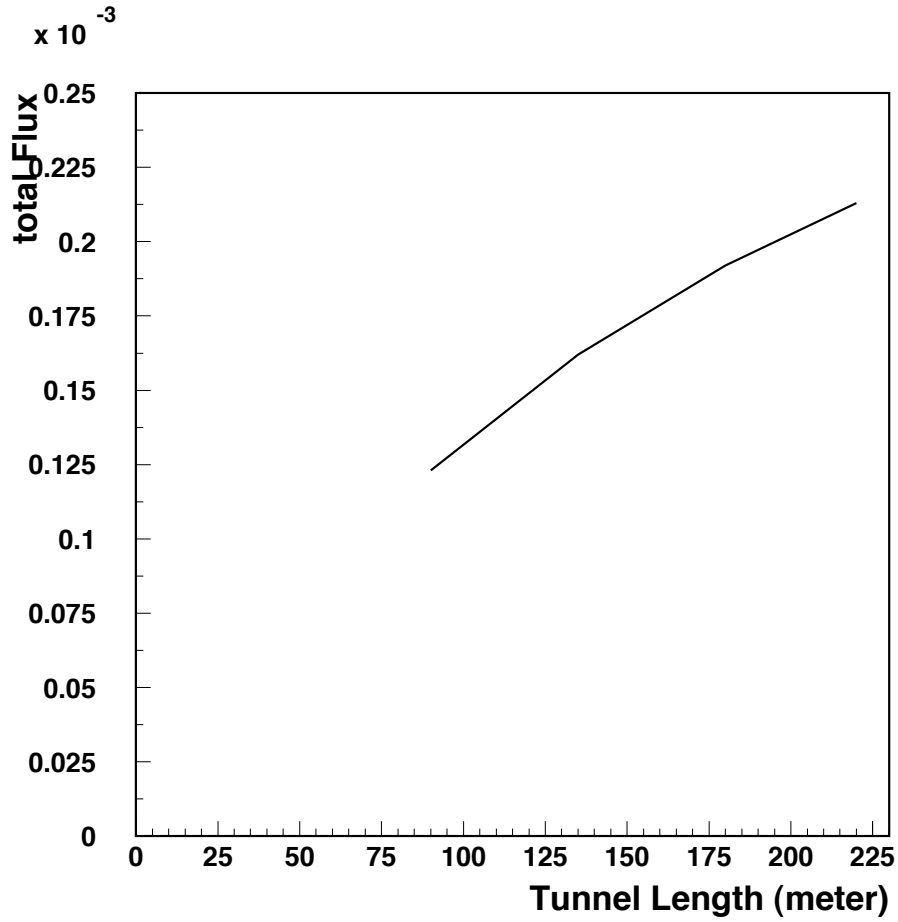




Same flux if vacuum; lose 3-5% in window.
if 1/8" thick steel window

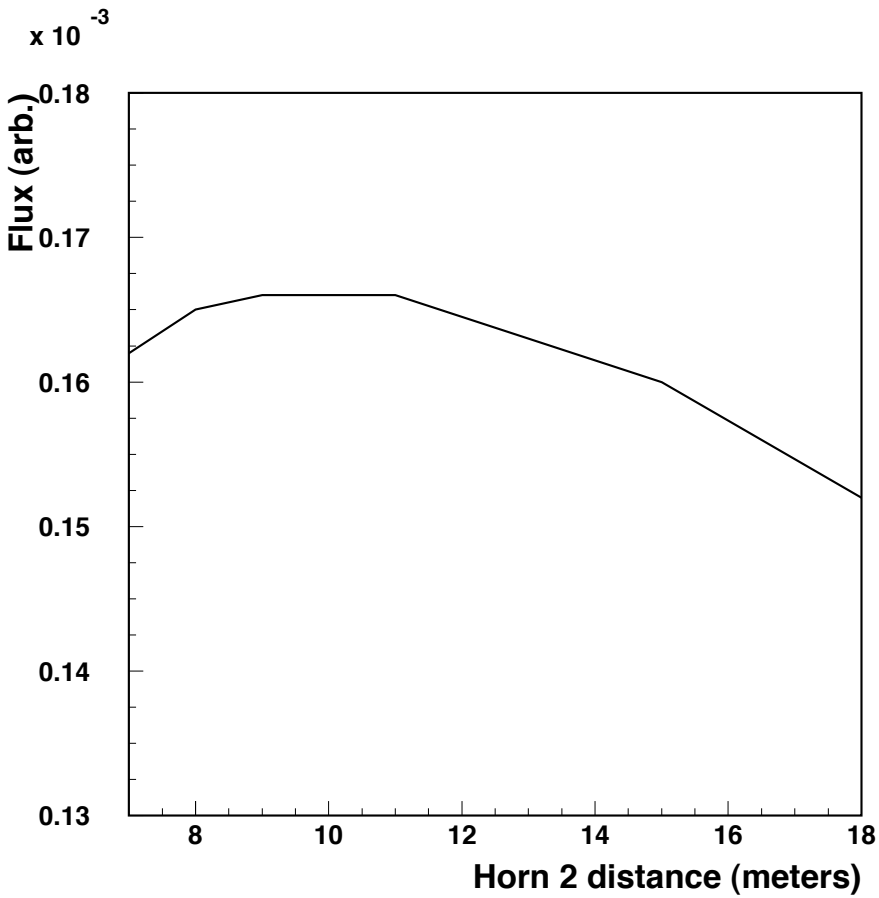
Tunnel dimensions

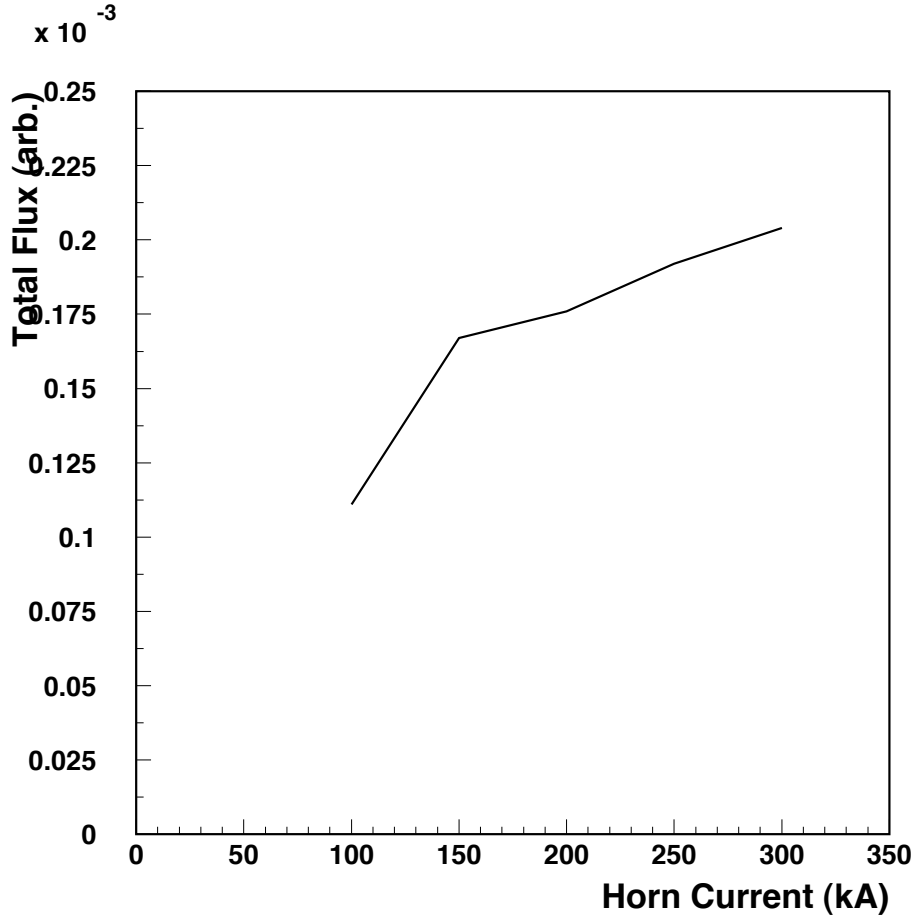




- Lose low E by making narrow
- Gain high E by making longer

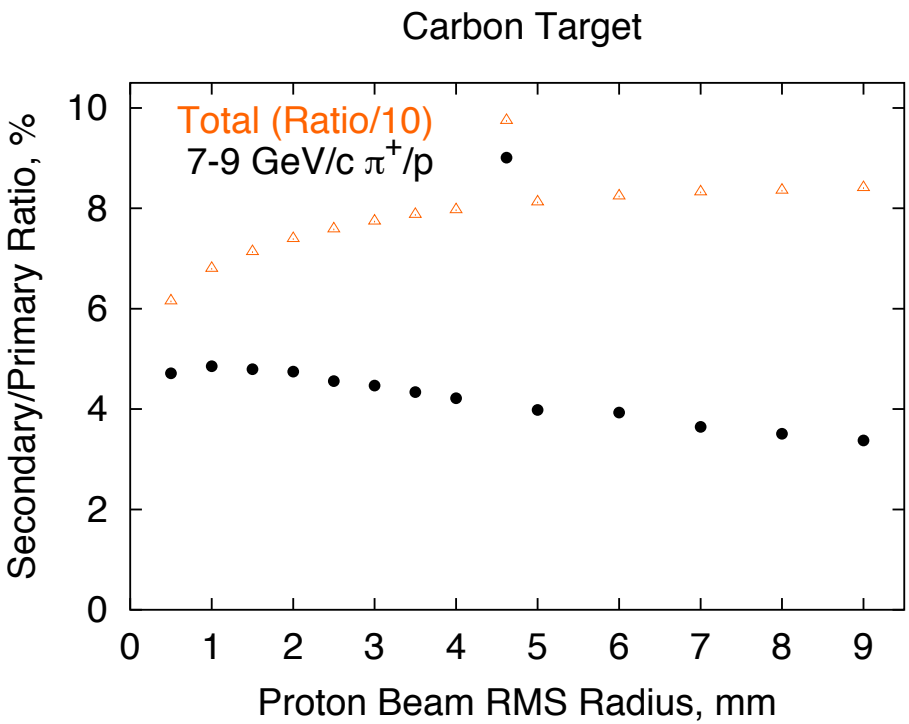
Horn placement and current





- Lose Low E if current goes beyond 500 kA
- Gain high E by placing horn 2 farther. Third horn ? But no He?

Target and beam dimension



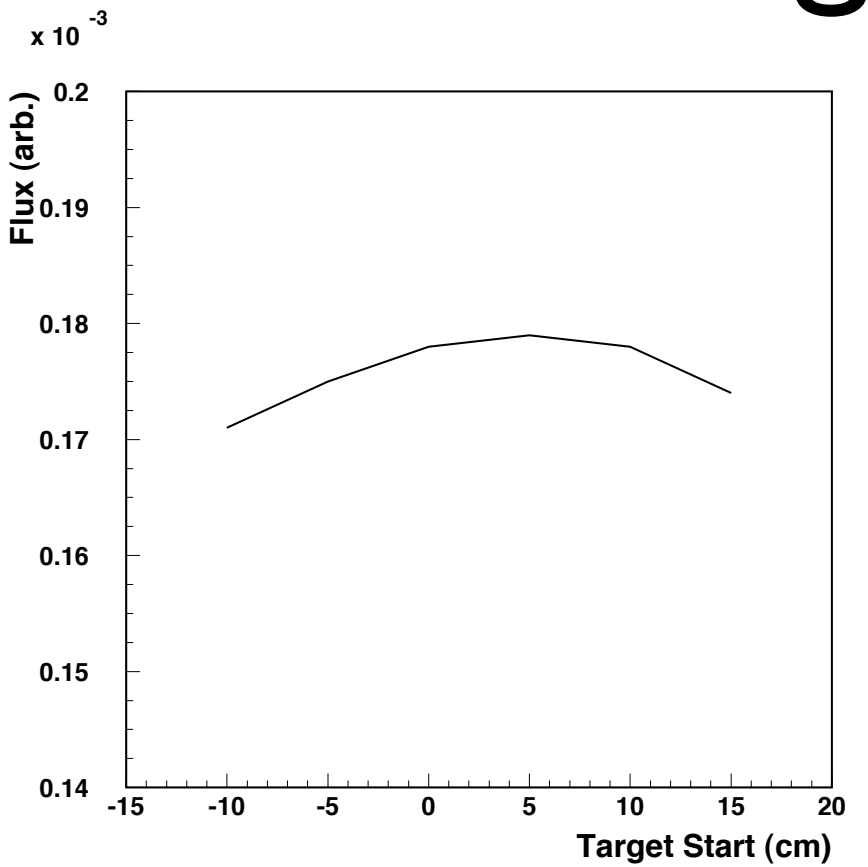
- 6 mm/2mm good compromise
- Must take care to control beam size.

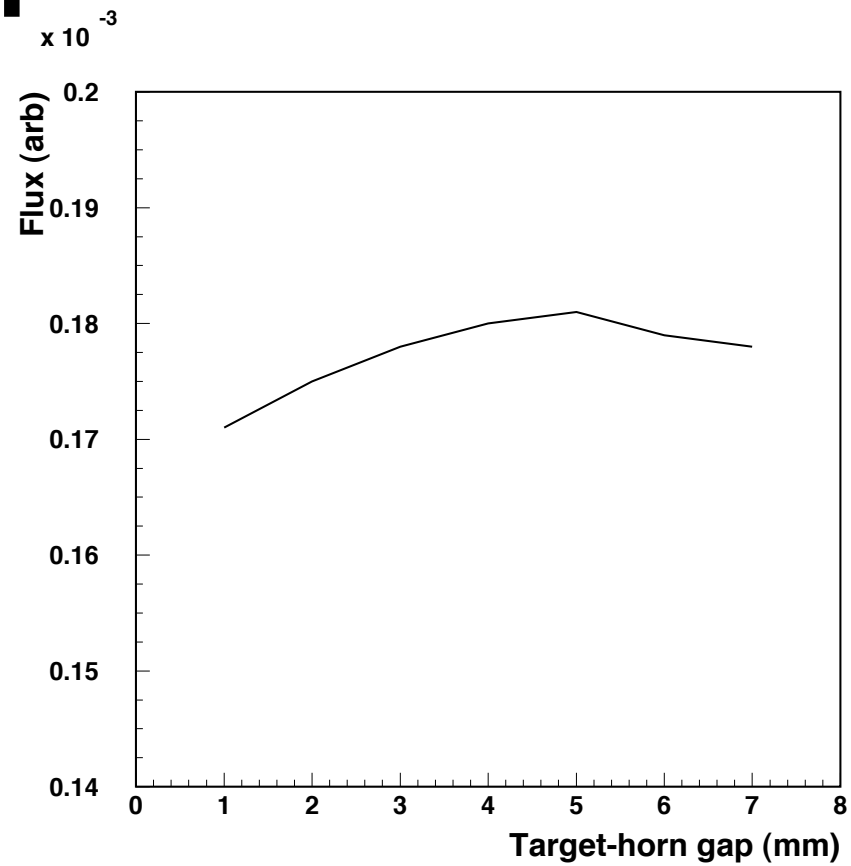
Target rad.

beam rad.	3mm	6mm	8mm
1mm	5.22 1.58	4.64 1.36	4.37 1.28
2mm	4.19 1.19	4.45 1.21	4.65 0.96
3mm	2.87 0.79	4.00 0.99	4.10 0.96

Flux in arb. units
Top: tot. flux; bot:>3 GeV

Target placement and gap





- Lose low E if target pushed in
- Lose low E if gap too large

What needs to be done

- Much better understanding of hadronic production.
- Much more detail of shielding and tunnel shape in the simulation.
- New simulation with optimized choices for parameters.
- 5 physicists needed for 2 years to perform studies and interface with AGS